

REVISED
Final
1998-99
Report

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Biogeography, Demographics and Potential Management of the
Mojave Fringe toed Lizard (*Uma scoparia*): A Species of Special
Concern at the NTC, Fort Irwin, CA and in Proposed Acquisition
Areas.

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Preface
To
The Revised Final Report

The original 1998-99 draft report was submitted to the Directorate of Public Works, NTC, Fort Irwin in December, 1999. The Directorate requested that minor corrections in the original text be undertaken for this revised final report. These corrections have been made. Furthermore, this revised final draft includes a summary of new research completed since December, 1999. This preface also highlights findings which may prove important to other cooperating agencies, the Environmental Management Directorate of Edwards Air Force Base, the California Department of Fish and Game, the Bureau of Land Management, Barstow, China Lake Naval Weapons Center and the National Park Service (Death Valley National Park). The reader is further advised that even this "final" report represents a work-in-progress, summarizing several related but separate studies which are far from completion. A more literally final report will be submitted to all cooperating agencies in September, 2000. It will be followed by the submission of three separate manuscripts to referred journals. Publications of these manuscripts, should they pass review, will be the definitive final reports- available to the entire scientific community and the concerned public as well. For the sake of clarity, new findings are itemized below:

1. The preliminary survey of all major dune systems in the northern and Western Mojave Desert is now complete. The major dunes and loose sandy soil systems examined included virtually all such habitat units in Inyo, Kern, Los Angeles, Mono, and San Bernardino Counties of California. Federal properties surveyed included Edwards Air Force Base, Saddleback Butte State Park, the BLM Mirage Lake OHV recreation area, the China Lake Naval Weapons Center (north range only), Afton Canyon riparian habitat-BLM, and Death Valley National Park.

2. These studies included about 10 hrs of field surveys (hrs X # of surveyors) per site during June - September, 1998 and again during June - October, 2000.

a. Results indicated that the Mojave fringe-toed lizard does not occur north of Ibex Dunes west of Saratoga Springs in Death Valley National Park. This is the northernmost population of the entire species. Even the proximate Buckwheat dunes, only about 10 kms north, were devoid of fringe-toed lizards. As a result Ibex Dunes supports the only population known within DVNP. They were previous reports, some in popular literature refer to this lizard at Panamint Dunes and near Stovepipe Wells, DVNP. None of these reports were substantiated even after 20 hr searches at optimal activity hours during June

and July (most sites between 0700-0900 hrs PST). Fringe-toed lizards were also absent from dunes at Saline Valley and Eureka Dunes. Similarly, no dunes examined North or West of Harper Dry Lake supported Fringe-toed lizards. None in Kern Co., and none in the small dunes at the Naval Weapons Center.

b. Preliminary results also indicate that this species may have extirpated from the entire Victor and Antelope Valleys during the last 40 years. If year 2000 surveys confirm the loss of these historical populations, extirpation may have reduced the entire range of the species by approximately 20% of its total range. Such a finding, may represent a trend moving east from the most developed, polluted and fragmented corner of the California Mojave Desert. If so, threatened or endangered species should be considered by both CDFG and USFWS. Records from the 1930-60 period document fringe-toed lizards from the Silver Lake area, Harper and Mirage Dry Lakes, from Wilsonia Gardens and the vicinity of Saddleback Buttes, and from several washes due south of these localities. All sites visited still contained sandy habitat. Again 20 hrs of surveys at each site during the 1998 and 1999 summers produced no confirmed sightings. Several of these localities have been confirmed by voucher specimens (in LACMNH). As result mis-identification is not an explanation (see below).

c. Four localities at Edwards Air Force Base were reported by biological surveyors. At two North Base sites (Buckhorn Ridge area, west of Lancaster Blvd. And north of Rosamond Blvd.) we were unable to find suitable habitat. At the two remaining sites in the vicinity of the Precision Impact Range Area (PIRA) near the southeastern border of the Base (one near Haystack Butte), sufficiently sandy soils were located, but no fringe-toed lizards were found after two separate site visits.

d. At Edwards Air Force base and at Panamint Dunes, DVNP, unpublished or popular reports may be mis-diagnoses based upon sightings of dune dwelling zebra-tailed lizards, Callisaurus draconoides. Dune dwelling zebra-tailed lizards, occur syntopic (co-occurring) with fringe-toed lizards, and allopatric (geographically separate) from them, often resemble the latter species. "Dune ecotype" zebra-tailed lizards may average smaller adult size, manifest less sexual dimorphism, and exhibit dorsal pigmentation with a distinctly golden tan, enhancing their crypsis (camouflage) on sandy substrates. These same character states make it more difficult to distinguish the two species. However, zebra-tailed lizards may be distinguished from fringe-toed lizards, even at a distance. While both species have black cross banding on the ventral sides of their tails, only zebra-tailed lizards have dark cross bars on the dorsum of the tail of the former species, in contrast to the solid tan dorsum of fringe-toed lizards. Furthermore, the distinctive

ocelli which cover the entire dorsum of fringe-toed lizards may be distinguished from the large isolated black spots, white "frosting" of males, and dark chevrons of zebra-tailed lizards. Large male zebra-tailed lizards also display blue ventrolateral patches which are entirely absent from all fringe-toed lizards.

3. Genetic sampling (tail clips) assessment has been completed for virtually all Mojave Fringe-toed lizard populations known, excepting only those which may have been recently extirpated. Methods, loci, and genealogy based upon preliminary DNA sequence data are provided in a separate section of this report. Since that section was completed in December, 1999, one important phylogeographical outcome has been revealed by subsequent cladistic analyses. The basal clade of Mojave fringe-toed includes only its three most northern (and separate) populations: Ibex Dune in DVNP, Dumont Dunes (an OHV recreation site on BLM lands along the Amargosa River), and the very isolated falling dune sequestered in the northeast facing basaltic slope of the Soda Mts. at Red Pass, just south of current Fort Irwin boundaries, but within its proposed land expansion. The counterpart to this basal clade is composed of all remaining populations, which appear to follow a genetic continuum along the Colorado and Mojave Rivers.

This genetic dichotomy in affinities is important. The basal northern clade includes only three populations, and only one of these (Ibex Dune) are completely protected. Furthermore, differentiation of this well developed clade indicates that a considerable interval of time kept the northern populations separate, possibly in dunes wedged between the glaciopluvial antecedents of the Baker Sink and Lake Manly. In such a setting and under isolation of sufficient duration (perhaps several hundred thousand years) physiological adaptations to local climatic, geomorphologic and ecological conditions may have developed. Genetically, these northern populations may prove to be as distinct from the southern clade as the endangered Coachella Valley fringe-toed lizard (*Uma inornata*) is from the more widespread Sonoran fringe-toed lizard (*Uma notata*). Therefore, these northern populations, along with a distinctive population of fringe-toed lizards at Mohawk Dune, Arizona, may prove to be distinct species. Should such a taxonomic revision take place, the new species designating the northern clade should be as state and federally endangered, just as has the Coachella Valley fringe-toed lizard.

4. A distribution map of all dune habitat localities examined, their current occupation by fringe-toed lizards and their genetic affinities will be produced separately. It will be provided to the NTC, and to all interested parties within the next thirty days.

5. Only one site within the current boundaries of Fort Irwin, the dunes north of Bitter Springs, supports Mojave Fringe-toed lizards. After 10 years of field surveys, we are confident that this is only location in the NTC. It occurs across an approximately 5 Km wide arc running from due

north the due east from the northern tip of the "whale" basaltic flow north of Bitter Springs. All of this habitat lies north of the current "Off Limits" boundary protecting the Bitter Springs desert/riparian wetlands. This arc of sandy habitats involves low and partially stabilized dunes and washes. These are favored sites for concealing tanks during military training rotations. However, similar landscapes are available for training just a few kilometers further north. Therefore, we recommend that Bitter Springs Off Limits Area be expanded north and east to include most or all of the fringe-toed lizard habitat. Prompt implementation of such an action would anticipate future state or federal listing). Such "pro-active" protection now would obviate the high cost of compensating habitat loss or implementing habitat restoration later. This local population has genetic affinities with the widespread Mojave River clade including Afton Canyon, East Cronese Dry Lake, and Coyote Dry Lake populations.

6. A primary objective of the yr. 1999-2000 Mojave fringe-toed lizard NTC contract is the completion of a detailed survey of the localized demes and their distribution among contiguous and isolated sand habitat units surrounding the "Whale" basaltic cap and the adjacent dune habitat north of Bitter Springs. These surveys will provide a mapped data base for planning an effective expansion of the protective "Off Limits" area around Bitter Springs. Furthermore, each sandy habitat unit will be mapped by GPS, outlined on remote sensing habitat maps, and scored for border to surface area ratios, total surface area, shape, and connectivity. Transect characterizations of vegetation and its stabilization effects on dune sands will also be developed, soil samples taken and analyzed for composition by grain size (percentiles) and major chemical characteristics, and frequency estimates for all diurnal lizard species will be recorded (using up to twenty five 100m transects). Multivariate statistical techniques will identify which combinations of variables best predict fringe-toed lizard absence, presence and frequencies. Ultimately, these studies, supplemented by similar studies from East Cronese Lake south across I-15 toward the Mojave River flood plain will be used to model minimum viable and optimal habitats (dune characteristics) for this species.

7. In addition to a final report in year 2000, we are in the process of preparing, revising or submitting three manuscripts for publication in referred journals:

a. Trepanier, T. L. and R. W. Murphy. Submitted. The Coachella Valley fringe-toed lizard: genetic diversity and phylogenetic relationships of an endangered species. Molecular Phylogenetics and Evolution.

b. Trepanier, T. L. and D.J. Morafka. In preparation. The phylogeography of the Mojave Fringe-toed lizard (*Uma scoparia*): Does gene flow follow water and sand flow? To: Systematic Biology or Journal of Herpetology

c. Morafka, L. Hazard and T. L. Trepanier. In preparation. A habitat model for the Mojave Fringe-toed lizard (*Uma scoparia*): in the northern limits of its range: Estimating minimum viable dune size. To: Journal of Arid Environments- potentially a yr. 2001 issue dedicated to 20 years of environmental studies at Fort Irwin.

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Introduction

Recognizing the possibility that this species of CDFG "special concern" may be elevated to state/federal threatened or endangered status, The NTC has contracted this study to:

- 1 inventory Mojave fringe-toed lizards (*Uma scoparia*) population in, or proximate to Fort Irwin.
- 2 assess overall status of the species.
- 3 provide an ecogeographical model identifying potential habitat, including estimations of minimum dune size, shape, and connectivity, and Minimal viable population size in a genetic context.
- 4 Provide recommendations for designing future HCPs for both current the current NTC reservation and for proposed LAQ properties.

This report provides preliminary results from the first year of a two year study, terminating in the Fall of 2000. The final project report will model sand dune habitats, predicting potential Mojave fringe-toed lizard distribution on the NTC and adjacent properties being considered for land expansion. In this way critical habitat may be placed off limits long before populations or their sustaining ecosystems are compromised by training impacts. Such pre-planning could cut years of delay and ambiguity from land acquisition negotiations and provide better management for the sensitive species. The costs of management would be considerably lower to the NTC when habitat damage is circumvented and viable populations are simply placed "off limits". Otherwise, "after the fact" mitigation, using problematic and costly techniques, would be needed to correct disturbances that could have been avoided without compromising the primary training mission of the NTC.

This annual final report is based incorporates data and expertise already resident at DPW, ITAM TEC, LSU, MDEI/USU. It also includes data and results previously presented in less formal previous reports.

Objectives

The set of specific objectives includes:

- a. Define the local distribution of the fringe-toed lizard;
- b. Define the ecological character and delimit connectivity of the unique dune habitats it occupies;
- c. Determine the minimum viable dune size (a modification of the Minimum Viable Habitat - MVP - concept), using the fringe-toed lizard as a diagnostic "umbrella" species.

Dune size would be correlated against lizard population sizes and densities. These values would be assessed genetically, using PAUP, and MEGA programs for comparative analyses, and F-statistics to evaluate gene flow between local populations (demes), and to assess the viability of small local isolates in terms of genetic drift/inbreeding depression. Each gene will be evaluated separately, as well as all genes combined. The estimations of phylogenetic relationship will be examined in light of an independent geologically based hypothesis of dune history. Estimates of genetic variability will be examined in light of life history attributes, individual vagility/dispersion, and population density.

Methods

These actions are itemized in the sequence in which we executed operations during this first funded year.

1- Complete the distribution of the Mojave fringe-toed lizards in relation to dunes. These extend across the southern borders of the NTC from Coyote Lake (NW shoreline) to Bitter Springs, Red Pass, along the north face of the Powerline road into the potential expansion area east and south of Red Pass. Similar areas at Dumont Dune and the SW slopes of the Kingston Range will also be examined. We would map these findings and publish the results, identifying both the geographical and ecological range of *Uma* in the assigned area. A total of 15-30 discrete dunes will be evaluated.

2- Complete gap analysis of current protection of *Uma* populations (matching protected to inhabited habitats, as ratios) - utilizing GIS/remote sensing imagery.

3- Complete dune systems in both biotic and geomorphologic terms; inventory and photo document dune dominant species and coarse grain habitat differences.

4- Determine dune sources, determine sand sheet flow direction, and predict future stability and direction.

5- Determine dune antiquity, with the assistance of consultant geologists.

6- Determine minimum dune size sustaining a MVP of fringe toed lizards through GPS ordination and planimeter estimation of dune size. WE WOULD TARGET THREE DUNES OF MINIMUM, MEDIAN, AND MAXIMUM SURFACE AREA TO EXAMINE LIZARD POPULATION DYNAMICS IN DEPTH THROUGH REPRESENTATIVE STUDIES. Characteristics of a comparable set of dunes lacking fringe-toed lizards would be contrasted statistically with those harboring these lizards.

7- Determine individual dune population size in terms of both absolute and local density, based on mark and recapture. We

are now evaluating alternative techniques, using different statistical estimations and marked individuals (AVID emissive tags, tattoo numbering, or bead markers).

In collaboration with Dr. R. W. Murphy (genetics subcontract), we would:

- a. Continue to obtain mitochondrial DNA sequences to assess the extent of genetic variability within and among dunes and dune systems. Variants will be identified using cutting-edge SSCP (single strand conformational polymorphism) technology. The sequence data will be evaluated using parsimony tree construction methods, and the resultant trees will be compared to geologically determined histories of the dune systems. The extent of variability will be correlated with estimates of population size to search for patterns of genetic variability relative to ecological and life history traits.
- b. Sequence additional genes in order to provide a more robust estimation of relationships.
- c. DNA microsatellites have been proven to be extremely valuable in evaluating gene flow and estimating genetic variability within populations. Such data may be critical to forming management guidelines for endangered, threatened species, as well as for species of special concern like the Mojave fringe-toed lizard.

8- Determine genetic variation both within and between dune populations, using specific gene sequences to establish the degrees of inbreeding /isolation as evidenced by F value coefficients. PAUP and MEGA programs may be utilized for comparative studies. Fast evolving genes, such as cytochrome b and ATPase 6 have been shown effective at discriminating related populations which have been divergent for < 6,000 yrs. These sequences will be employed in this study utilizing non-lethal tail muscle sampling from 5-10 individuals per dune.

Products

We anticipate the production of sophisticated and interdisciplinary habitat model, building upon the recovery plan for the Coachella Fringe toed lizard (*Uma inornata*), but significantly more integrative in its resolution of disparate data- and being generally applicable throughout the Mojave Desert. A model of this quality should be submitted to an appropriate referred journal.

A. Representative Study Sites Surveyed: Table 1 provides a comprehensive list of all 27 dune sites sampled for this study. This table compiles UTM coordinates, dates of sampling,

soil sample verification, fringe-toed lizard, *Uma scoparia*, presence, presence of the potentially competitive zebra-tailed lizard, *Callisaurus draconoides*, and dune characteristics such as greatest diagonal diameter, shape, height, and stabilization by vegetation. Almost all Mojave Desert dune systems between the Techapi Mts. And the Baker Sink were sampled in Inyo, Kern, and San Bernardino Counties, California and Nye Co, Nevada. Despite several references in popular and "gray" literature, we were unable to verify any extant populations north of Ibex Dunes, DVNP, Inyo Co., California, or west of the Mojave River in the vicinity of Barstow.

Table I

Characterization of Potential Sand Dune Habitats Sampled for the Mojave Fringe-toed Lizard (*Uma scoparia*) in the Northern Mojave Desert in 1998-9

(Sites will also be ordinated on the forthcoming remote sensing map)

Locality Name	UTM/Elev.	Date	Soil Sample	<i>Uma* Callisaurus</i> *	Dune Description Size* Shape	Stability
1. Ibex Dune DVNP, Inyo C., CA	1150556686 3952465 Elev116m	7/3/99	+	+	lg, >5 barchan	low
2. Buckwheat Dune, DVNP	11505492707 3960236	7/3/99	+	0	med, 3 falling	low
3. Panimint Dunes, DBNP	110459650 4034786		+	0**	lg >3 star	low
4. Eureka Dunes, DVNP	110439176 4107136	10/99	+	0	med 3 barchan	low
5. Saline Valley, DVNP			+	0	small	med?
6. Stovepipe Wells, DVNP	110493497 4055094	7/5/99	+	0	lg > 5 barchan	low
7. Amargosa Dunes, NV	110538521 4055512		+	0	small	

Locality Name	UTM/Elev.	Date	Soil Sample	<i>Uma Callisaurus</i>	Dune Description Size* Shape	Stability
8. Barstow, CA	110491347 3860815	7/6/99	+			
9. Silver Lake San Bernadino CO., CA	110468550 3842485	7/6/99	+			
10. Edwards Haystack Butte, Kern CO., CA	11440862 3857720	10/8/99	+	0?	Small Low D<1km	High
11. Cronese Lake, CA	0564246 3888798	10/15/98	+	+	Large Low	Low
12.	0567126 3884828	10/15/98	+	+		
13. E. Cronese Lake, CA	0564313 3886730	10/15/98	+	0		High
14. 1st GPS	0563992E	10/11/98				

Locality Name	UTM/Elev.	Date	Soil Sample	<i>Uma Callisaurus</i>	Dune Description Size* Shape	Stability
location	3904009		+	+	0	Low
15.	0563886E 3903495	10/11/98	+	0	0?	Low
16.	0564118 3903765N	10/11/98	+	+		Low
17.	0478952E 3879159N	10/10/98	+	0?		High
18.	0564722E 3905164N	10/12/98	+	+	+	Low
19.	0563874 3886508	10/15/98	+	0		Low
20.	0564724 3904259N	10/14/98	+	0?	0	High

Locality Name	UTM/Elev.	Date	Soil Sample	<i>Uma Callisaurus</i>	Dune Description Size* Shape	Stability
21.	0564489E 3904180N	10/14/98	+	0 0		Low
22. Mojave River, CA	0554300E 3878036N	10/9/98	+	+		
23.	0566912E 3884999N	10/9/98	+	0?		High
24.	0566521E	10/9/98	+	0?		High
25.	0576753E 3883196N	10/8/98	+	+		Low
26.	0576659E 3887685N	10/8/98	+	+	+	High
27.	0579054E 3883869N	10/8/98	+	0?		

Locality Name	Date	Soil Sample	<i>Uma Callisaurus</i>	Dune Description Size* Shape	Stability
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* = *Uma & Callisaurus* columns may have blank spaces because presence/absence data for one or both species remains unresolved at the time of this writing. All such sites will be revisited in year 2000.

B. Distributional Status within the NTC and in Proximate Habitats: Map 1 ordinales seven localities which have been known to supported fringe-toed lizards currently, or in the historical past and which are in the NTC or lie within properties which are candidates for land acquisition. The status of these seven sites are as follows:

-1. Dune system surrounding Crucero: along the Mojave River east of Afton Canyon and west of Soda Dry Lake. Dunes are low, stabilized, diffuse, and interconnecting. Fringe-toed lizards are abundant in some, but not all, of these dunes. Stabilization, large cemented sand grains, and possibly recent flooding episodes may help explain their exclusion from some highly stabilized sandy soils. Falling dunes also occur here, especially on the eastern slopes of local basaltic flows.

-2. West Cronese Dry Lake: a landscape of low, unevenly stabilized and interconnecting dunes, especially along the southern lake shore. Fringe-toed lizards are generally abundant and widely distributed. However, they are absent from the coarse-grained falling "dune" on the south face of the Cronese Mts. Likewise, they were absent from low semi-stable dunes along the south shore of E.Cronese Lake and just north of I-15. The lizards do occur on small dune spits interdigitating with basaltic flows between the SE edge of W.Cronese Lake and the NW corner of E.Cronese Lake.

-3. Red Pass: The falling dune on the NE facing slope of the Soda Mts., facing Red Pass Dry Lake does support an abundant fringe-toed lizard just 1 km south of the current NTC SE border. The smaller dunes above this falling dune, and facing west (toward Bitter Springs) are sorted for more coarse grain deposits and are devoid of fringe-toed lizards, though zebra-tailed lizards do occur there. The fringe-toed lizard population is entirely isolated, and genetically distinct from Bitter Springs lizards, less than 10 kms to the west.

-4. Bitter Springs to Langford Road: the valley is bordered by the "whale" on its west- extending about 5kms due east,, Langford Road to the north, and Bitter Springs proper to the south. "Off limits" perimeter should be extended north from Bitter Springs proper to the NE corner of the Whale, continuing east 5 kms to inscribe an inverted triangle terminating on Langford Road on its north. These are low lying, partially stabilized dunes with abundant annual and perennial vegetation. These dunes are impacted by military traffic. The undulating low sand hills are attractive to tank crews wishing to

conceal their location during training. However, the "critical" habitat occupies less than 1 % of the NTC, and many alternative sites would afford the same opportunities for tank concealment. Current "Off Limits" perimeters of the desertoriparian wetlands at Bitter Springs afford no protection to this species.

-5. Small sand spits on the west and east slopes of the Whale: These are scheduled for detailed mapping and inventory in 2000. They represent potential but unconfirmed habitat, disjunct, small are variable in extent, shape and sand grain size.

-6. Afton Canyon: SW of the Canyon proper, small sand spits (< 1 km) on the north side of the flood plan of the Mojave River do support small diffuse clusters of fringe-toed lizards. These sand spits are partially stabilized by mesquite (*Prosopis*), and creosote (*Larrea*). While these small populations would never be incorporated into NTC LAQ proposals, lateral displacements of aeolian deposits from more proximate training, or diversions of Mojave River flood water could degrade these already marginal habitats by either covering or cementing the very limited spits of loose small sand grains.

-7. Coyote Lake: NW corner approximately 1-2 kms south of Jack Rabbit Springs. These low stabilized dunes support a small population of fringe-toed lizards. These dunes are generalized stabilized by perennial vegetation and entirely surrounded inappropriate habitat, alluvial soils to the north, and alkaline flats to the south and east. The longest diagonal across these dunes is only 1-2 kms in length. This area is peripheral to a proposed land acquisition and it could be affected by aeolian deposits displaced down wind from new training sites.

Map 1

Distributional of Known and Potential Mojave Fringe-toed Lizard Habitats Proximate to the NTC, Fort Irwin.

Comment: See Map 2 for scale and key to features. The top of the Map is to the north.

Key to circled numbers, habitat highlighted in yellow:

- 1- Crucero dune complex*
- 2- West & East Cronese Dry Lakes*
- 3- Red Pass falling dunes*
- 4- Dunes north of Bitter Springs*
- 5- Dunes/spits peripheral to the "Whale"-?
- 6- Afton Canyon- Mojave River flood plain*
- 7- Coyote Dry Lake*

Map 1

Distributional of Known and Potential Mojave Fringe-toed Lizard Habitats Proximate to the NTC, Fort Irwin.

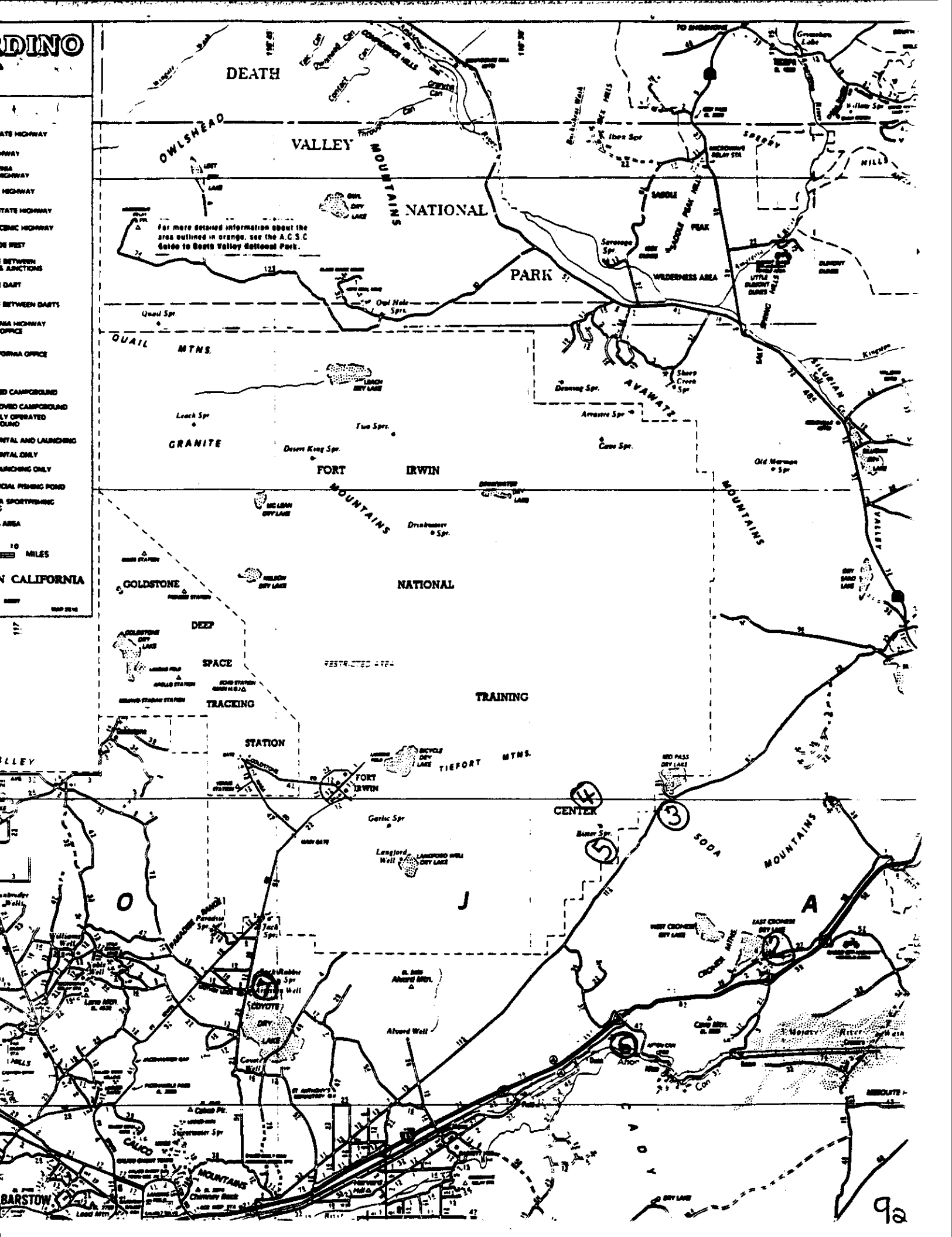
Comment: See Map 2 for scale and key to features. The top of the Map is to the north. For specific localities also examine the final technical appendix on distributions starting on p.17.

Key to circled numbers, habitat highlighted in yellow:

- 1- Crucero dune complex*
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C. Selection of Representative Dunes for Studies: Small dunes along the western periphery of the "Whale" lava flow remain potential habitat for fringe-toed lizards and will be completely mapped (GPS/GIS) surveyed in 2000. In this way minimum dunes sizes, shapes, and connectivity will be determined. Similarly, "archipelagos" of small dunes will be examined along the periphery of West Cronese Dry Lake to determine if replicate correlations exist relative to those reported for the "Whale" and adjacent Bitter Springs.

D. Extant Distribution & Extirpation of Fringe-toed Lizards in the far western Mojave Desert (especially Antelope Valley): Map 2 illustrates simply the current status of fringe-toed lizard populations in the Harper Dry Lake and Antelope Valley. Several visits during Summer and early Fall, 1999 to the following localities yielded NO CONFIRMED SIGHTINGS. If repeat surveys during May - July, 2000 fail to yield any further reports, we may conclude that this species has been extirpated from the northwestern 20% of its historical range. Key sites inspected in 1999 included the following, most of which have produced past records in Los Angeles County Museum of Natural History (LACMNH) collections, CDFG Species of Special Concern documents, or military "in house " literature:

-1. Harper Lake: According to LACMNH collections. these lizards historically inhabited the Harper Dry Lake area. During two separate searches encircling the dry lake, no suitable habitat or fringe-toed lizards were encountered.

-2. Silver Lake: LACMNH records confirm its historical presence in flood plains of the Mojave River in this region about 30 kms N of Victorville. However, the river bed has been high modified for flood control to project adjacent lakes and development. No lizards were observed in what appeared to be suitable habitat.

-3. Mirage Dry Lake: LACMNH, Stebbins 1954 field guide document the occurrence of this species at Mirage Dry Lake. Local dunes appeared to be "plowed" by massive and repetitive OHV traffic, destroying perennial vegetation and altering dunes surfaces. Near by agricultural endeavors may have also generated laterally displaced exposures to aerial pesticides (crop "dusting"). No individuals were located even after three full morning searches by 3-5 member survey teams.

-4. Saddle-back Butte State Park/Wilsonia Gardens: Little or no suitable habitat was observed within the state park. Sandy habitat by Wilsonia Gardens, south of the park, yield circumstances much like those at Mirage Lake. Here, however, multiple garbage dumps were apparent as an

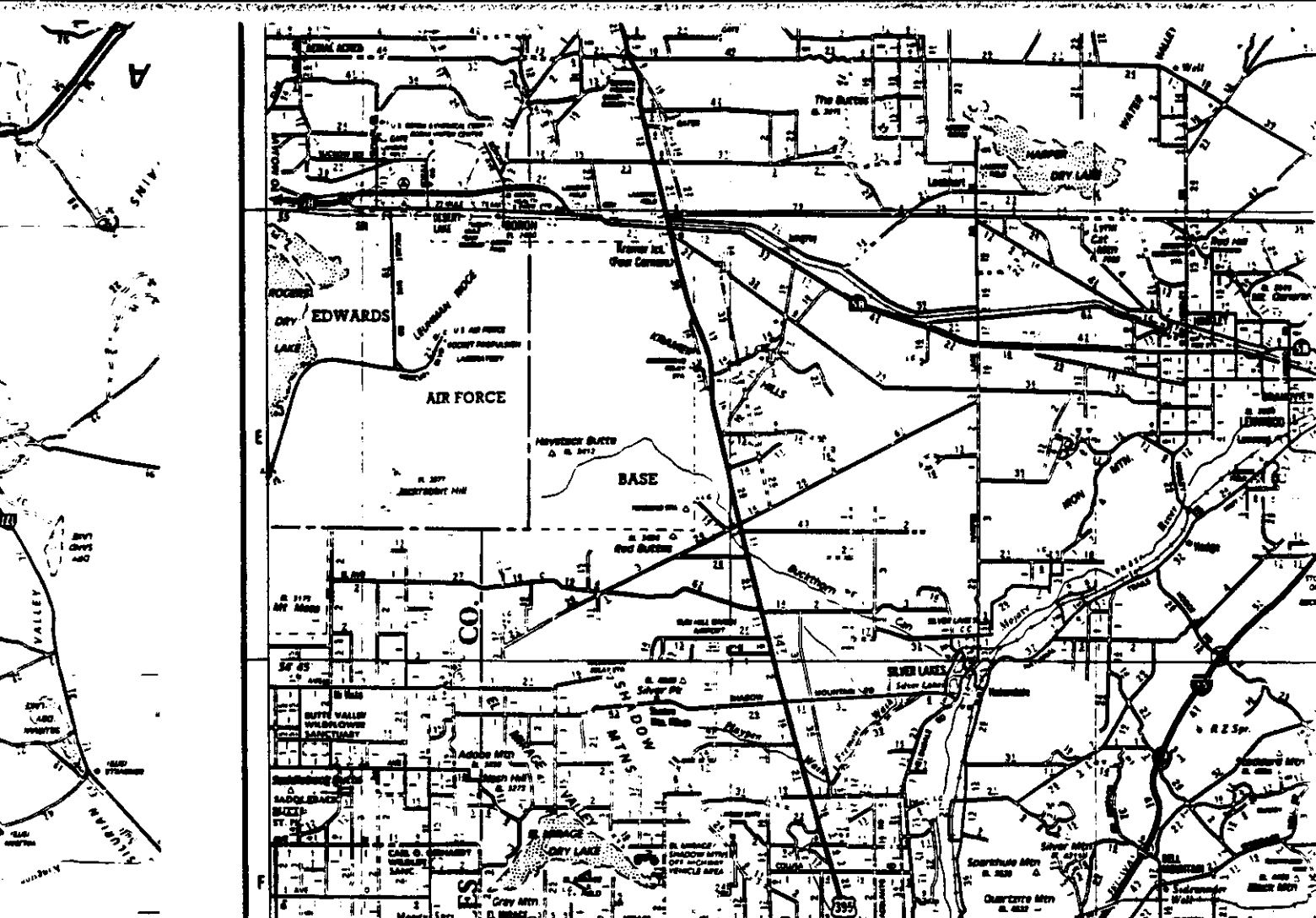
additional element in potential habitat degradation. Again LACMNH confirm the past preserve of fringe-toed lizards at these localities.

-5. Edwards Air Force Base: During the early 1990's contracted biological inventories reported four localities for this species at EAFB. Of these, we were able to confirm suitable low dunes, highly stabilized in small (several hectare) area southwest of Haystack Butte (see Table 1 for site characteristics). No confirming sightings were made after two morning visits in late Summer-Fall, 1999. Further surveys in 2000 are recommended.

Map 2.

**Antelope Valley and Harper Lake Sand Habitats
Examined for Apparent Extirpation of the Mojave
Fringe-toed Lizard**

Comment: Key and scale are included on the map itself. Sandy potential, or historically documented habitat, are highlighted in pink. For specific localities also examine the final technical appendix on distributions starting on p.17.



SAN BERNARDINO COUNTY

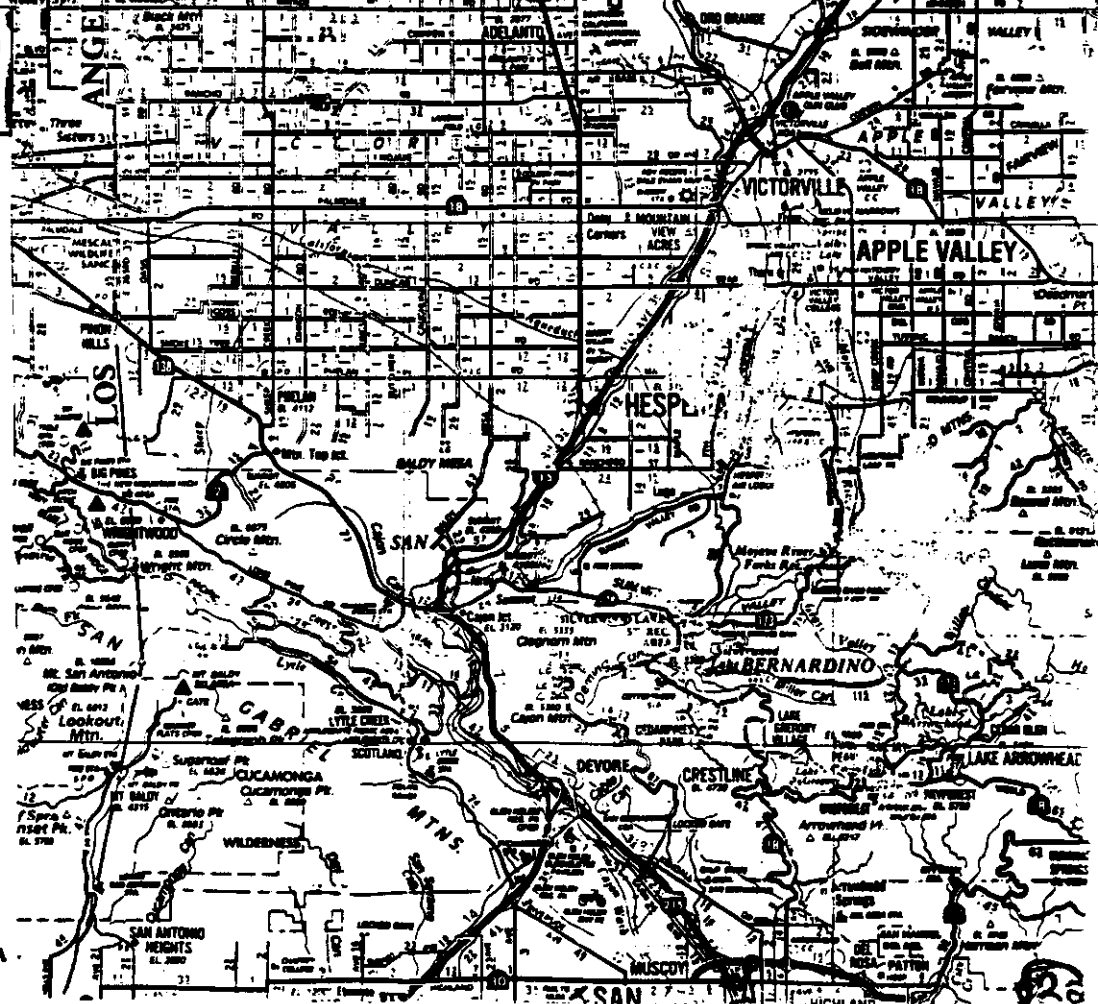
LEGEND

- | | | | |
|--|----------------------------|--|-----------------------------------|
| | FREIGHTWAY | | INTERSTATE HIGHWAY |
| | FREEWAY UNDER CONSTRUCTION | | U.S. HIGHWAY |
| | DIVIDED HIGHWAY (MAJOR) | | CALIFORNIA STATE HIGHWAY |
| | PAVED ROAD | | COUNTY HIGHWAY |
| | LOCAL ROAD (PAVED) | | OTHER STATE HIGHWAY |
| | GRAVEL ROAD | | STATE SCENIC HIGHWAY |
| | GRADED DIRT ROAD | | ROADSIDE REST |
| | DIRT ROAD | | MILEAGE BETWEEN TOWNS & JUNCTIONS |
| | POOR ROAD | | MILEAGE DAILY |
| | LOCKED GATE | | MILEAGE BETWEEN DARTS |
| | RAILROAD TRAIL | | CALIFORNIA HIGHWAY PATROL OFFICE |
| | WATER | | |

RECREATION

- | | | | |
|--|----------------------------------|--|---------------------------------|
| | PARK | | IMPROVED CAMPGROUND |
| | PUBLIC GOLF COURSE | | UNIMPROVED CAMPGROUND |
| | PRIVATE/SEMI-PRIVATE GOLF COURSE | | PERMANENTLY OPERATED CAMPGROUND |
| | WINTER SPORTS AREA | | BOAT RENTAL AND LAUNCHING |
| | AUTO RACETRACK/DRAG STRIP | | BOAT RENTAL ONLY |
| | OFF-HIGHWAY VEHICLE AREA | | BOAT LAUNCHING ONLY |
| | PUBLIC SHOOTING RANGE | | COMMERCIAL FISHING POND |
| | | | DEEP SEA SPORTFISHING LAUNCHING |
| | | | SURFING AREA |

SCALE 0 1 2 3 4 5 6 7 8 9 10 MILES



E. Status as a species of Special Concern: This species might be better viewed as a species complex which include several putative evolutionary species, as different genetically from one another as the Coachella Valley fringe-toed lizard (*Uma inornata*) from the Colorado Desert fringe-toed lizard (*Uma notata*)-see the Murphy/Trepanier subcontract report. Most relevant to the NTC is the Dumont Dune population in Silurian Valley, which is distinct genetically and lies in an area peripheral to one proposed land acquisition corridor. Its affinities to proximate but disjunct populations at Red Pass and Bitter Springs are still being resolved. Given the complex genetic differentiation of ecological isolates within this nominal "species", the aforementioned evidence of its extirpation from the western Mojave Desert becomes more provocative. An eastward moving trend toward extirpation could extend to the Barstow area as far east as Baker along Interstate 15 and to Ludlow along Interstate 40, given expected human growth and development in those areas over the next 20 years. Further modification of the Mojave River watershed and associated aquifers could further compromise habitats maintained on open flood plains bordering the river. Similarly, suburban sprawl, mining and agriculture could compromise habitat east of 29 Palms, impinging on the now robust populations of lizards associated with dunes at Dale Dry Lake. It is quite possible that the Mojave fringe-toed lizard and its undescribed allies may be awarded state endangered or federal "threatened status during the next five to twenty years. More detailed studies are needed to resolve the local status of its populations and establish the long term trends which would, or would not, justify such a change in legal status- particularly in the northwestern third of its historical range.